TECHNICAL MEMORANDUM ADDRESSING POTENTIAL OCCURRENCES OF FEDERALLY THREATENED, ENDANGERED AND CANDIDATE PLANT SPECIES AT HAILE GOLD MINE PROPERTIES, LANCASTER COUNTY, SOUTH CAROLINA

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Introduction

In support of the permitting for the proposed mining activities within an approximate 4,224-acre (ac) (1709-hectare, ha) area at Haile Gold Mine (Haile) property in southern Lancaster County, South Carolina, surveys were conducted to identify the presence of six federally threatened, endangered or candidate plant species (Table 1). As the project area is located in Lancaster County and near Kershaw County (Figure 1), plant species listed for Kershaw County are also included out of an abundance of caution. Other adjacent counties, Chester and Chesterfield, are not known to contain federally listed plant species (Charleston Ecological Services 2012). Georgia Aster (*Symphyotrichum georgianum*), a well-known regionally recognized federal candidate species, was also suggested for inclusion because of its geographic proximity to the project area. The species selected for the Haile survey display geographic and habitat similarities that could help promote their presence within the project area. All these species have been, at least historically, documented in Kershaw and/or Lancaster Counties. Geographic and habitat affinities may also allow presence of these species within the project area. The six species appearing in Table 1 will be discussed in greater detail later in this memorandum.

Table 1. Federally listed or candidate plant species documented for Lancaster and Kershaw Counties, South Carolina (Names for plant species follow Weakley 2011.) (http://www.fws.gov/charleston/countyLists.html)

Common Name	Scientific Name	Federal Status
Schweinitz's Sunflower	*Helianthus schweinitzii* Torrey & A. Gray	Endangered (E)
Smooth Coneflower	*Echinacea laevigata* (C. L. Boynton & Beadle) C. F. Blake	Endangered (E)
Georgia Aster	*Symphyotrichum georgianum* (Alexander) Nesom	Candidate (C)
Michaux's Sumac	*Rhus michauxii* Sargent	Endangered (E)
Pool Sprite	*Gratiola amphiantha* D. Estes & R. L. Small	Threatened (T)
Black-spored Quillwort	*Isoetes melanospora* Engelmann	Endangered (E)

The purpose of this memorandum is to examine the current status of the above species and relate what is known about their ecology to conditions at Haile. Further, it will be necessary to discuss observations, methods and results of seasonal surveys made over time throughout the project area to document other floral elements. Important details of the species and characteristics of their local distributions and most favorable habitats will also be examined with respect to the Haile project area, discussed in greater detail below.

Summary of Findings

During the course of the surveys at Haile carried out over a period of three years (2008-2011) all habitats types which might support any of the above threatened, endangered or candidate plant species were investigated. All of the habitats were covered multiple times, during multiple seasons over multiple variations of each basic habitat type. At no time was there sufficient evidence to consider that any of the listed species was present or that there was an optimum complement of all necessary habitat features present and functional allowing support of the species.

Landscape Surveys and Methodology

Seasonal plant species surveys followed purchase of the Haile Gold Mine by Romarco Minerals Inc. as the prospect of mining again became feasible. These surveys began at Haile in 2008 with a portion of landscape of about 1,500 ac (607 ha), known as Parcel A, that included much of the watershed of Haile Gold Mine Creek and became the subject of initial prospecting by Haile (Figure 2). Surveys of Parcel A area were begun 27 May, 2008. Visits were made during the periods 27-29 May, 8-10 July, 10-12 September and 22-24 October of the same year. An early spring survey, usually performed in late March, was not made. During the course of the surveys other aspects of the biophysical setting were also examined. These further efforts were made to better understand overall growing conditions and to aid in future interpretation of site characteristics especially with respect to rare plant species.

Seasonal surveys of a second parcel, Parcel B, of about 160 ac (65 ha) began in March of 2009 and ended October, 2009 (Figure 2). Visits were made to survey this parcel 29 March 2009, 15-16 June 2009, 11-12 August 2009 and 7-8 October 2009. Survey aims and products were the same as for the above parcel. Parcel B is also called the Small Tract.

A third set of seasonal surveys was completed in Parcel C (Figure 2) which consists of roughly 2,300 ac (931 ha). This survey began during late August of 2010. Visits were made over the periods of 23-26 August 2010, 5-8 October 2010, 21-24 March 2011, 16-20 May 2011, 11-14 July 2011, 29-31 August and 1 September 2011, and 17-19 October. Since there were two increments of landscape added by Haile non-concurrently to this parcel, survey times were staggered so that a final seasonal survey in the last-added portions of this parcel occurred October, 2011.

Familiarity with landscapes within the Haile boundary has been gained over multiple years and multiple seasons. Most of these lands have been covered multiple times to provide a clear picture of the total diversity of the landscape, its physical gradients and vascular plant components. Some gradients occurring over landscapes can be followed where major physical and biological factors change. Major changes in such gradients, as those for moisture, light, topography, exposure, fire and visible or inferred disturbance can be followed on foot as they occur through habitat complexes. Even though vegetation units have been defined and mapped as a part of the surveys, these units are not abrupt pencil lines with respect to their actual distributions and adjacencies. It is important to be aware of each major set of gradients as they become intertwined, overlap and otherwise vary over the landscape or across a vegetation unit.

To assess gradient variations, all work, except for some slow roadway surveys, was carried out on foot. General coverage goals were set for the day each morning. When potentially important habitat complexes were encountered, additional time was taken to review representative variation of the complex in more than one area. The direction of travel was marked and the pace was slowed. Side branches off the main direction of travel were followed where loops, angles and parallel traverses were employed to intercept important elements of the perceived habitat diversity. To some these meandering methods may seem more or less arbitrary and possibly haphazard since they are never strictly random and never rote. Random, with respect to a landscape gradient, may mean little in gaining an understanding of a continuously varying habitat complex.

Random surveys, grids and parallel compass headings followed in rote fashion are best for searching for plants within a previously determined set of complex or simple gradient sets (Mueller-Dombois 1974). These are useful methods with a prior understanding of a particular species' habitat limits and ascertain knowledge of its presence. They will allow occurrences of target species to be found within a restricted area. When the aim is to locate the overall habitat of the species, compass lines become a distraction, except to keep one from losing one's way. Following gradients was essential to this sort of study where known habitat characteristics for a known set of species were missing. Finding the habitat comes first if luck does not first turn up the species. Searching for the target species within the habitat must follow if the species is not, by chance, found first. Potential habitat, when found, became the subject of rote surveys.

Some habitats are defined by linear rights-of-way. Woodland margins paralleling paths, roads, highways and power lines are examples. Power line corridors are very limited within the project area and those that are present were found to be maintained by herbicides. This method of management of power line corridors curtails recruitment and survival by most rare plant species. Road margins allowing easy access were surveyed by vehicle. Power line corridors were checked for herbicide damage and ignored or followed as warranted.

Many habitats have been modified by the construction of drilling pads and their access roads. Forest edges follow many such roads pushed through woodland habitats. Such habitat modifications are found in all parcels, but some in Parcels A and B may not have been covered since they were created after completion of the survey. However, it is doubtful that such freshly disturbed area would sustain any of the target species (Table 1).

Since completion of earlier surveys for Parcels A and B, there has been a gap of time during which prospecting activities at Haile have continued. These activities have been responsible for various sorts of landscape modifications. Clear-cutting activities have been responsible for removal by previous owners of many acres of loblolly pine plantation and other previously forested habitats. More recently the extent of prospecting has increased such that drilling pads now dot the landscape throughout most of Haile lands. The construction of drilling pads and

supporting access roads has created much more edge habitat through the somewhat more stable, though still relatively young, habitats that previously occupied land Haile has purchased. Such an increase of new edge habitat has the effect of opening soil for additional pioneer plant species as well as species applied for soil stabilization. Some of these new species have been accounted for where disturbed sites have been visited; others may have been missed where parcels were covered earlier. Important target species were not found where such areas were visited.

Synopsis of Characteristics of Federally Listed Plant Species Listed in South Carolina

Schweinitz's Sunflower is a federally endangered plant species considered to be restricted to a 60-mile radius of Charlotte, North Carolina (U. S. Fish and Wildlife Service 1994). It has been documented for eastern York County, South Carolina near the North Carolina-South Carolina state line and at three locations in the adjacent northwestern pan handle of Lancaster County, South Carolina roughly three miles north of Hancock (Matthews, et al. 1997; Matthews and Howard 1999). The species has not been documented from Kershaw County (Matthews, et al. 1997 and Matthews and Howard 1999; SC DNR 2011). The South Carolina Heritage Trust Program (SCHTP) was queried for GPS (Global Positioning System) locations of this species in Lancaster County and Kershaw Counties. Only the three locations mentioned above are maintained by SCHTP.

Schweinitz's Sunflower is a member of the sunflower family, Asteraceae, typified by having many flowers in heads or capitula with ray and/or disk flowers that offer the appearance of single, multi-petaled flowers. This sunflower is perennial**.** It grows each year from an underground tuberous root stock, enlarges through summer and produces flowers from stems often as much as three to five ft (1-1.5 m) tall and occasionally taller. Leaves are opposite lower on the stem, lanceolate in general outline with cuneate bases that narrow to a short petiole. Leaves are alternate above and branches above give rise to single heads with yellow ray and disk flowers. Each head is relatively small and is enclosed by a set of small modified leaves called phyllaries (the involucre) that open to expose the young disk and ray flowers. Phyllaries are generally appressed to slightly spreading (not squarose) at the tips. Leaves are rough scabrous above and soft hirsute below, which, along with the thickened tuberous roots that store nutrients and with involucres about 1.5 cm across, are characteristic for the species (US Fish and Wildlife Service 1994).

The habitat of Schweinitz's Sunflower is best characterized by open, prairie or savanna-like conditions subject to intermittent fire or some form of disturbance that eliminates competitors for light and root space. Habitats are now largely found along mechanically or fire-maintained roadsides, woodland edges, utility corridors and the like. In eastern North America, areas dominated by herbaceous or shrubby species do not long remain available for such species without active maintenance. Major extrinsic repetitive habitat factors are sources of regular disturbance, both to competitors for direct sunlight and those vying for root space in the soil. Disturbance agents that can function in such a capacity include fire, mowing and, though unlikely, wind events capable of clearing overtopping competitors and/or disturbing soil surfaces. These factors are largely missing from the project area.

The habitat medium of Schweinitz's is usually circum-neutral Alfisols associated with the series Enon (Ultic Hapludalf), Iredell (Typic Hapludalf), Mecklenberg (Ultic Hapludalf), Wilkes (Typic Hapludalf) and Zion (Ultic Hapludalf). The central concept of Hapludalfs (that is a Typic Hapludalf) is a soil with an argillic (clay) horizon with a relatively high base saturation (circum-neutral). Ultic Hapludalfs are an intergrade with Ulitisols and have a somewhat more weathered clay component. These soils are not characterized by sandy surface materials (Soil Survey Staff 1999). Soils thus described are generally derived from mafic materials, but this species is also known to occur on highly weatherable felsic materials. Badin (Typic Hapludalf), Cecil (Typic Hapludult), Misenheimer (Aquic Dystrocrept) and Gaston (Humic Hapludult) are among the variety of soil series in which the speices has been noted, if soil maps are correct (US Fish and Wildlife Service 1994). These soils are absent from the project area.

Known botanical associates of Schweinitz's Sunflower indicate a parallel degree of fire tolerance and need for disturbance. Big Bluestem (*Andropogon gerardii*), several species of *Asters (*Symphyotrichum* spp.), *Wild Indigo (*Baptisia tinctoria*), *Silky Oat Grass (*Danthonia sericea*), several species of *Tick Trefoil (*Desmodium* spp), *Red Cedar (*Juniperus virginiana*), Cudweed (*Gnaphalium helleri*), Birdsfoot Trefoil (*Lotus helleri*), *CommonWild Quinine (*Parthenium integrifolium*), *Post Oak, *Blackjack Oak,

Coneflower (*Ratibida pinnata*), *Little Bluestem (*Schizachyrium scoparium* var. *stoloniferum*), Yellow *Indian Grass (*Sorghastrum nutans*), *Fish Poison (*Tephrosia virginica*), *Winged Sumac (*Rhus copallinum*) and others are found with this species (US Fish and Wildlife Service 1994). All but Big Bluestem, Cone Flower, Birdsfoot Trefoil and Cudweed have been noted in the project area. Species found within the project area are marked with an asterisk (*).

Schweinitz's Sunflower was not found within the project area and important habitat factors for this species appear to be lacking.

Smooth Coneflower is a federally endangered plant species known to currently occur in only scattered locations in the states of South Carolina, North Carolina, Virginia and Georgia. The species is now thought to be extirpated from Arkansas, Alabama, Maryland and Pennsylvania (U. S. Fish and Wildlife Service 1995). The species has a documented location in Lancaster County within four or five miles of Haile as determined by the SCHTP somewhere within a 1.5-mile circular radius near a power line corridor. It is not known to occur in Kershaw County but has been documented from six other counties, Aiken, Allendale, Barnwell Oconee, Pickens, Richland, in South Carolina.

Smooth Coneflower is a member of the sunflower family, Asteraceae, which is typified by having flowers in heads, separated into two kinds as ray flowers that resemble individual petals and disk flowers that are small and centrally located. A sheathing group of modified leaves forms an involucre composed of individual phyllaries or modified leaves. Rays, drooping over the upper edge of the involucre up to 2 in, (5 cm) long, and disk flowers are shades of pink and purple, respectively. Leaves, up to 8 in ((20 cm), are alternate, basally disposed and cauline, sharply toothed and petiolate; surfaces are smooth to somewhat roughened. Stems may reach 4ft (1.5 m) in height. Plants are perennial from vertical root stocks (Radford et al. 1968, US Fish and Wildlife Service 1995).

Smooth Coneflower occupies habitats similar to those in which Schweintiz's Sunflower is found. It is a survivor of pre and early European eastern prairie habitats for which the only modern day counterparts are linear, open habitats maintained as power line corridors, cedar barrens, road edges and other forest edge situations.

Soils in which Smooth Coneflower grows are generally circum-neutral and, in North and South Carolina based on diabase hardpan clay with a xeric character. Vegetation over areas of shallow rock is maintained, at least to some extent, by the shallowness of the soil. Such shallow soils over rock would better be described as Lithic Hapludalfs, but such soils have not been mapped in the area (US Fish and Wildlife Service 1995, Schafle and Weakley 1990).

Species often found with Smooth Coneflower include several species of *scrub oaks (Post, Blackjack) and Chinquapin Oak, *Red Cedar, *Red Bud (*Cercis canadensis*), *Persimmon (*Diospyros virginiana*), various species of *Blueberry (*Vaccinium* spp.), *Winged Elm (*Ulmus alata*), *Fringe Tree (*Chionanthus virginicus*), Haw (*Viburnum rafinesquianum*), *Black Haw (*Viburnum purnifolium*), *Common Oat Grass, *Little Bluestem, Curlyheads (*Clematis ochroleuca*), *Narrow-leaf White-topped Aster (*Sericocarpus linifolius*), *St. Andrews Cross (*Hypericum hypericoides*), Veiny Hawkweed (*Hieracium venosum*), *Beaked Hawkweed (*Heiracium gronovii*), Blazing Star (*Liatris virgata*), *Northern Rattlesnake Master (*Eryngium yuccafolium*) and others. Species diversity in maintained habitats can shift to other sets of herbaceous species with the advent of fire or mowing. Such events can be fully or partially responsible for maintenance of these habitat types. Species found during the course of these surveys are marked with an asterisk (*).

Smooth Coneflower was not found within the project area and important habitat factors for this species appear to be lacking.

Georgia Aster is being reviewed as a Candidate (C) for listing under the Endangered Species Act. The U. S. Fish and Wildlife Service welcomes efforts to consider occurrences of this species. The species is documented by herbarium specimens under the name *Aster georgianus* for Kershaw, Richland, Fairfield, York, Cherokee, McCormick, Edgefield, Abbeville, Oconee and Pickens Counties (on-line South Carolina

Plant Atlas (A. C. Moore Herbarium 2008):, however, it does not occur in the SCHTP data base for any specific locations within the limits of Abbeville, Kershaw, Richland, Pickens or Edgefield counties (South Carolina Department of Natural Resources 2011). The reason for this apparent discrepancy is that there is currently no known exact, mapable location for the species, at least not in Kershaw County. It was last documented in Kershaw County in 1961(SCHTP database). However, an earlier specimen from Kershaw County was apparently collected by A. E. Radford in 10/6/57(#30139), which comes from information gathered from an unpublished paper (Matthews 1993). The location is given as "Alluvial forest, Little Lynches River, 5.5 mi SE of Kershaw." Matthews indicates that this location "…has a distinctly out of habitat concept." Matthews has checked the location (11/6/92) without finding the species.

At this writing, photographs supposedly representing this species at the South Carolina on-line plant atlas (A. C. Moore Herbarium On Line) are actually images of Common Clasping Aster (*Symphyotrichum patens*).

Georgia Aster is a medium to tall perennial of the Aster Family, Asteraceae, characterized by having heads or capitula that contain many ray and disk flowers that appear to represent a single flower. Plants range from a foot to several feet in height, are freely branched and have leaves that are heart-shaped at the base and clasp the stem on which they occur. Ray flowers are light to dark purple. Disk flowers are white and fade to a brownish purple with age. Heads are terminate the ends of branches and are surrounded as a group by an involucre composed of phyllaries. White disk flowers are used to differentiate this species from other closely related species such as Common Clasping Aster, which is scattered through the project area.

Georgia Aster is thought to be a relict species of the Piedmont Prairie in which both Schweinitz's Sunflower and Smooth Coneflower once occurred. Surrogates of such habitats presently occur along maintained rights-of-way following power line corridors, road and railroad margins and along other edge habitats where light is abundant (U. S. Fish and Wildlife Service 2010). Fire may be an important maintenance factor as well as mowing and other sources of surface disturbances limited to the top of the soil profile A Horizon. One reason considered for the rareness of this species is its self-sterile condition. Inability to set seed except through cross fertilization can limit distribution of a species when no or very few individuals occur nearby (Matthews 1993). Soils requirements of the species are poorly understood.

Based on the sorts of habitats currently occupied by Georgia Aster associated species include a variety of herbs and low shrub species, similar to those often occurring with Common Clasping Aster. These have been observed in the project area and include Winged Sumac, Plume Grass (*Saccharum alopecuroides*), several other species of aster (*Symphyotrichum* spp.), Goldenrod (*Solidago* spp.), Fish Poison (*Tephrosia virginica*), White-topped Aster (*Sericocarpus* spp.), Common Oat Grass and others.

Georgia Aster was not found within the project area and important habitat factors for this species appear to be lacking. However, Common Clasping Aster, easily confused with the Georgia Aster, was present along woodland borders and in a few power line corridors.

Michaux's Sumac is an endangered species listed under the Endangered Species Act of 1973. Three South Carolina counties, Florence, Kershaw and Oconee, once supported occurrences of Michaux's Sumac. This species now appears to have been extirpated from South Carolina (U. S. Fish and Wildlife Service 1993a).

Michaux's Sumac is a small, hirsute, clonal shrub with compound, leaves having 9-13 sharply serrate (sometimes doubly so) leaflets. Clones are characteristically unisexual. Flowers are born in a strictly terminal, compact, scarcely showy inflorescence that produces seeds attractive to birds and other wildlife species. Single sex clones can reproduce only asexually by growth and extension of underground rhizomes. When optimum growing conditions have been occupied by rhizomes, clonal plants become isolated. Hybridization is considered to be one of the factors leading to the disappearance of this species, and plants may have sets of characters, including being nearly glabrous, derived from near relatives including Dwarf Sumac and Smooth Sumac (*Rhus glabra*) that influence other character conditions including leaf rachis color, teeth of leaflets, petiole wings, etc.

Habitats for Michaux's Sumac are reminiscent of historical southeastern prairie habitats and so the modern counterpart is areas repeatedly maintained by fire, mowing or other type of clearing disturbance that does not mechanically disrupt the soil environment. Power line corridors, road edges, field edges and other somewhat linear habitats seem to favor this species. Fire appears to be of particular importance to this species, perhaps more than specialized soil conditions. Fire reduces shading and other sorts of competition, but apparently has little effect on seed germination in this species (Bolin et al. 2011). This species is more of a soil generalist and occurs in a wider variety of soils in both Sandhills and Piedmont physiographic provinces, though it is now considered extirpated outside of North Carolina and Georgia. Fire protection, forestry practices, development and agricultural habitat conversion are the greatest threats to this species (U. S. Fish and Wildlife Service 1993a).

In sandhill situations, at least in North Carolina, it may be found in submesic swales and loamy swales in association with a relatively select set of species (see below). In the eastern Piedmont it can be found on sandy soils derived from granite. Clayey soils associated with mafic rocks may support Michaux's Sumac in the central Piedmont. Habitats are in frequently burned areas (Weakley 2011).

Weakley (2011) suggests that Michaux's Sumac is most frequently associated with such species as Pitchfork Paspalum (*Paspalum bifidum*), Spreading Sunflower (*Helianthus divaricatus*), Carolina Triodia (*Tridens carolinianus*), *Dwarf Sumac, Green Silkyscale (*Anthaenantia villosa*), *Eastern Beardgrass (*Gymnopogon* spp.), and Woollysheath Three-awn (*Aristida lanosa*). Other, more common species associates are listed in the recovery plan (U. S. Fish and Wildlife Service 1993a). This list consists of several species of *Sumac (*Rhus* spp.), *Poison Ivy (*Toxicodendron* spp.), *Loblolly Pine, *Longleaf Pine, *Scrubby Post Oak, *Post Oak, *Blackjack Oak, *Black Cherry (*Purnus serotina*), *Chickasaw Plum (*Prunus angustifolia*), *Winged Elm (*Ulmus alata*), (*Sorgham halpense*), Common Toadflax (*Nuttallanthus canadensis*) and others representing more of a weedy habitat with scattered arborescent species that might occur through linear edges. Of these species those marked with an asterisk were found within the project area during the course of the surveys. Species occurring in the project area are marked with an asterisk (*).

Schweinitz's Sunflower was not found within the project area and important habitat factors for this species appear to be lacking. It is generally thought to be extirpated in South Carolina.

Pool Sprite and **Black-spored Quillwort** are federally threatened and endangered, respectively, under the Endangered Species Act of 1973. These two species have very specific habitat requirements found only in depressions supporting small, ephemeral pools on granite outcrops (U. S. Fish and Wildlife Service 1993b). Such habitat is present in Lancaster County at the Forty-Acre Rock State Natural Area, six miles north of Haile. These species can be found at that very restricted habitat and other granite outcrops. This very specific sort of habitat does not occur within project area. There are no exposed granite outcrops therefore these plant species or any plant species specific to granite exposures are not to be expected within the project area.

These species have no habitat within the project area and were not found.

Summary of Survey Findings for Threatened and Endangered Plant Species

During the course of the surveys at the Haile project area carried out over a period of three years (2008-2011) all habitats types which might support any of the above threatened, endangered or candidate plant species were investigated. All of the habitats were covered multiple times, during multiple seasons over multiple variations of each basic habitat type. At no time was there sufficient evidence to consider that any of the listed species was present or that there was an optimum complement of all necessary habitat features present and functional allowing support of the species.

Long-term and profound disturbances have been associated with habitats present within the project area. These areas have been farmed, subject to forest management and, more recently almost totally protected from fire. No evidence of fire either associated with controlled burning or uncontrolled wildfire was noted within the project area. Usually at least the bases of trees will show evidence of fire over a period of 20-30 years or more. No such evidence

was seen. Long-term fire protection in conjunction with long-term landscape disturbances largely preclude the presence of optimum habitat for the species considered in this survey.

Vegetation evidence indicates a history of open and confined grazing in the project area. This evidence comes by way of habitats where Loblolly Pines (*Pinus taeda*) are scattered through stands of young broadleaf hardwood forests, where a large component of Water Oak (*Quercus nigra*) is mixed with other species and where Loblolly Pine and Sweet Gum (*Liquidambar styraciflua*) dominate forested flats, ridges and slopes. Such vegetation shows where fields were abandoned. Open-range grazing and browsing were likely once used in the area to sustain various sorts of livestock. The remains of fencing materials in scattered areas throughout currently forested areas and along property lines offer more recent evidence of greater confinement for livestock. Livestock allowed to roam in confined or unconfined areas gradually create a shallow soil layer that remains in a state of intensive or extensive pedoturbation for a time. This sort of disturbance over time will not favor growth or recruitment of any of the rare species covered.

Based on observations made during the course of the surveys, a large proportion of Coastal Plain acreage within the project area was clear-cut and converted to Loblolly Pine plantation after 1990. Pine plantations have been planted closely adjacent to many secondary roads. More recently much of the land has been at least selectively cut for Loblolly and Longleaf Pine, leaving an assortment of broadleaf species in upland areas. More recent forestry practices avoid wetland areas, at least partially, allowing stream corridor and other wetter forest habitats to remain somewhat undisturbed. None of the target species listed in Table 1 are likely to be found in riparian or wetland habitats.

There are a few power line corridors that cross existing plant communities and parallel roads. These corridors are most similar to maintained habitats that might support some of the species mentioned above. Most such corridors follow secondary roads or highways where at least a part of corridor is road shoulder. Evidence offered by brown, dead plants in these corridors suggests power line corridors in the area are maintained by the use of herbicides and therefore could not support the target species. With this maintenance practice the likelihood of spray drift impacts not only plants within the corridors but plants that ordinarily thrive along and just inside corridor edges. Following spraying the most tolerant species will rebound while other species are either eliminated or considerably reduced in vigor. All of the target species would be susceptible to herbicides.

Other edges along fields, sandy unsurfaced roads, trails and the like have been surveyed repeatedly. Two general habitat factors are always absent, soils developed from mafic rock materials such as diabase and fire. Diabase rocks occur naturally in the project area in stream valleys and along some lower slopes, where Piedmont soils have been exposed under Coastal Plain sands and ironstone lenses. Many of these areas are forested and not considered adequate habitat for the federally listed species.

Two groups of soil parent materials are wide spread in the project area, Coastal Plain sandy materials and Piedmont Carolina Slate Belt materials derived from weathered felsic rocks. Soils formed from weathered weathered mafic rock materials (diabase) have not been mapped for the project area and only seem to appear as inclusions generally associated with widely scattered visible outcrops of diabase. Plant species found at these sites offer a vague suggestion of circum-neutral soils. Examples of two such sites were also associated with old house places. It is uncertain if past human activities at these house places were a factor in formation of the apparent circum-neutral soils. These and other diabase outcrop areas were surveyed carefully over the seasons and none of the species listed above were found. Circum-neutral soil types that might support old prairie habitats have not been mapped or seen in the project area.

Conclusion

None of the target species listed as threatened, endangered or candidate species in Lancaster and Kershaw Counties were determined to be a part of the floristic complement of plant communities within the project area. Complete habitats for these species are absent from the project area and their presence as established members is unlikely. Lack of favorable soils, lack of regular or frequent fires and prevalence of habitat disturbance are thought to be largely responsible.

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FIGURES

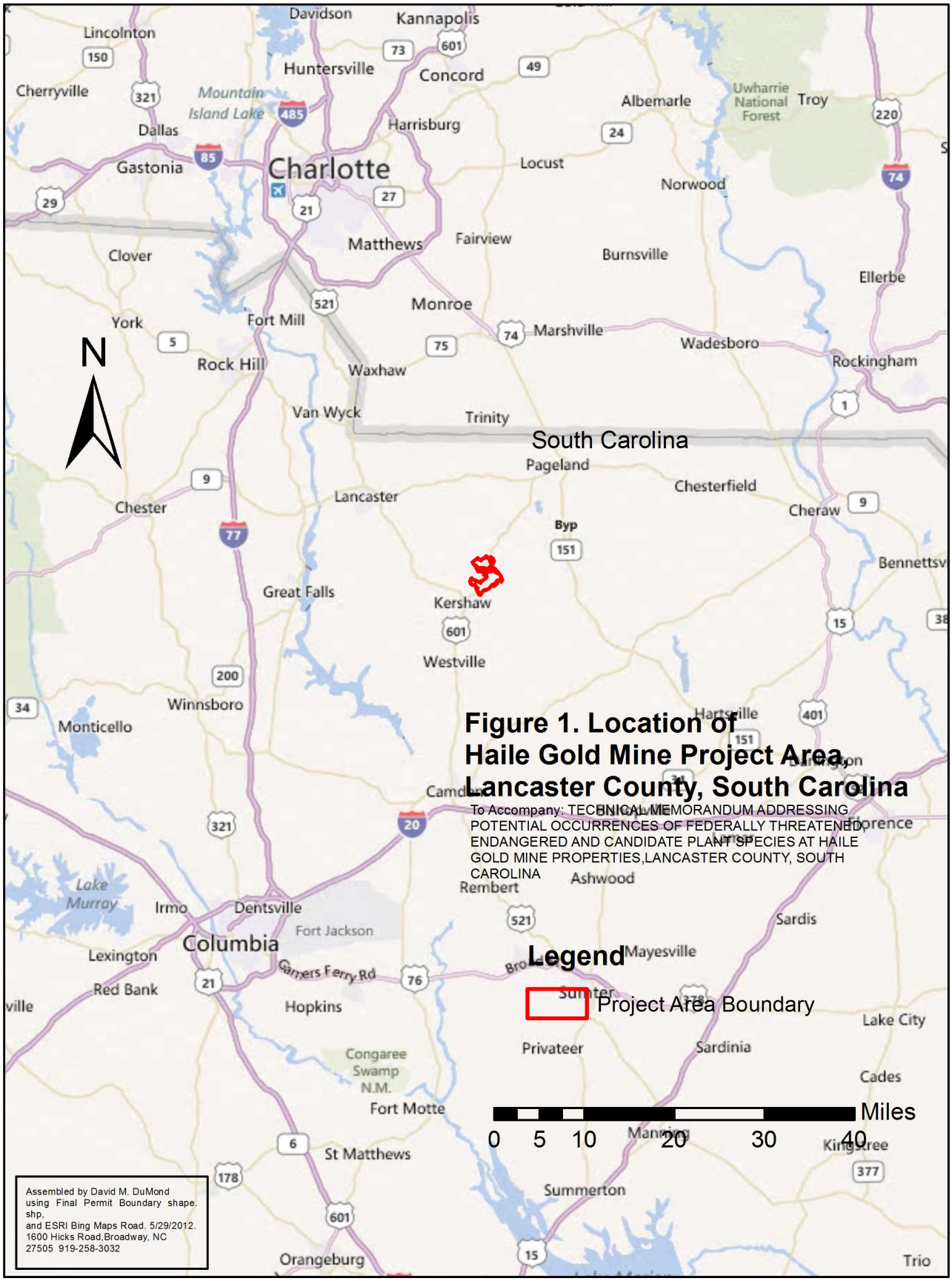

Figure 1. Location of Haile Gold Mine Project Area, Lancaster County, South Carolina

To Accompany: TECHNICAL MEMORANDUM ADDRESSING POTENTIAL OCCURRENCES OF FEDERALLY THREATENED, ENDANGERED AND CANDIDATE PLANT SPECIES AT HAILE GOLD MINE PROPERTIES,LANCASTER COUNTY, SOUTH CAROLINA

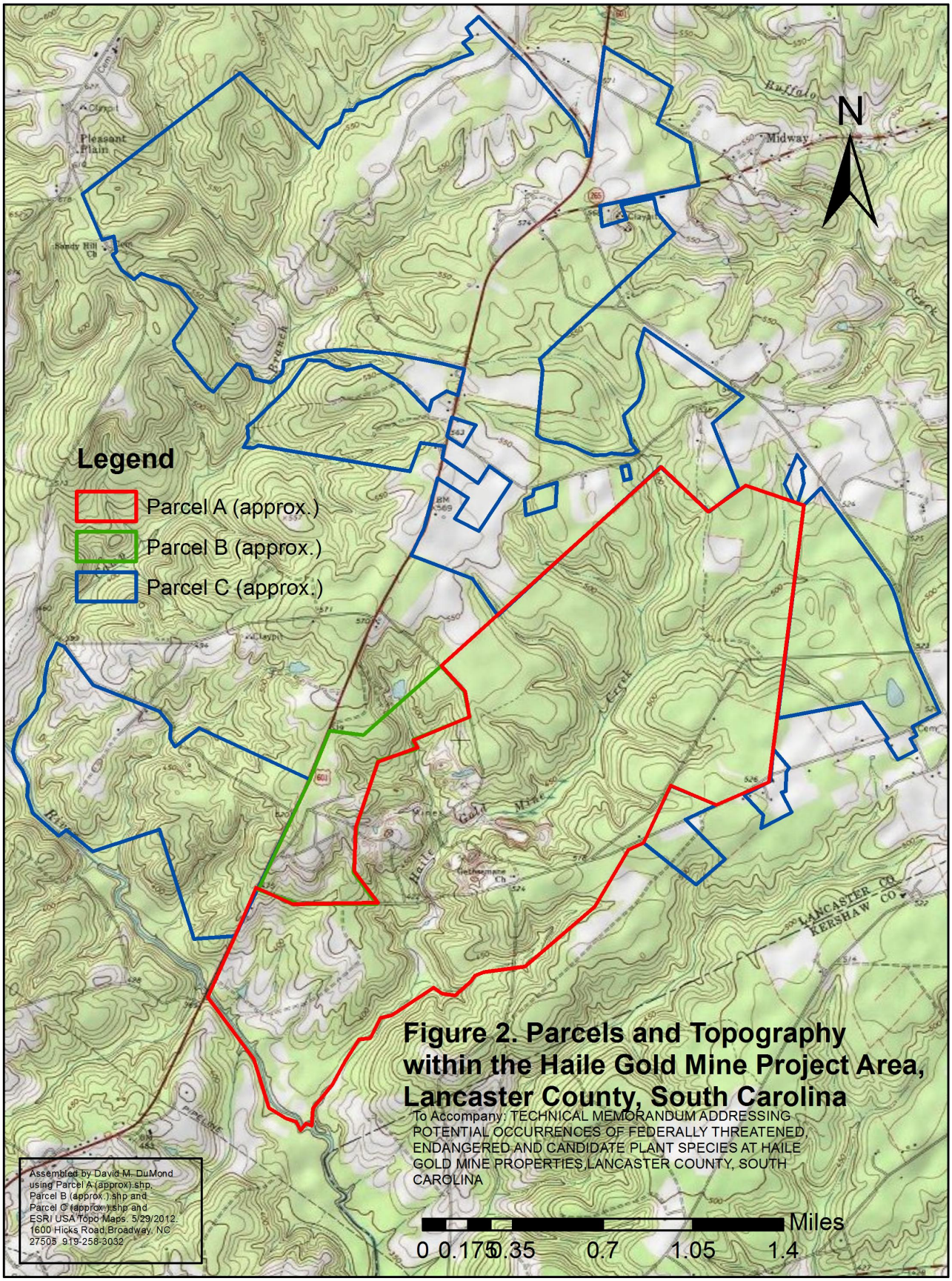

Figure 2. Parcels and Topography within the Haile Gold Mine Project Area, Lancaster County, South Carolina

To Accompany; TECHNICAL MEMORANDUM ADDRESSING POTENTIAL OCCURRENCES OF FEDERALLY THREATENED, ENDANGERED AND CANDIDATE PLANT SPECIES AT HAILE GOLD MINE PROPERTIES,LANCASTER COUNTY, SOUTH CAROLINA